

$$\begin{array}{r} 11 \\ 6x \\ \hline 66 \end{array} \quad \begin{array}{r} 12 \\ 6x \\ \hline 72 \end{array}$$

$$\begin{array}{cccccccc} 64 & 32 & 16 & 8 & 4 & 2 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 1 \end{array}$$

Question 1 [15 mark]

a- Perform the following conversions:

64 32 16 8 4 2 1

$$(1000111)_2 = (155)_6$$

$$(71)_{10} =$$

$$\begin{array}{r} 71/6 \\ \textcircled{5} \quad | \quad 11 \quad | \quad 6 \\ \quad \quad | \quad \textcircled{5} \quad | \quad 1 \quad | \quad 6 \\ \quad \quad \quad \quad | \quad \textcircled{1} \quad | \quad 0 \end{array}$$

- A 10
- B 11
- C 12
- D 13
- E 14
- F 15

$$(FAC9.4)_{16} = (175311.20)_8$$

$$\left(\underbrace{1111}_{17} \underbrace{1010}_{5} \underbrace{1100}_{3} \underbrace{1001}_{1} . \underbrace{0100}_{20} \right)_4 = (175311.20)_8$$

$$\begin{array}{r} 64 \\ 2^v \\ \hline 128 \end{array}$$

$$(1100101)_2 = (000100000001)_{BCD}$$

$$+(101)_{10} \Rightarrow (\quad)_{BCD}$$

$$\begin{array}{r} 64 \\ 32+ \\ \hline 96 \\ 4+ \\ \hline 100 \Rightarrow 101 \end{array}$$

$$\begin{array}{r} 128 \\ 64+ \\ \hline 192 \end{array}$$

$$(10010101)_{BCD} = (11000111)_{6-3-1-1}$$

$$\begin{array}{cc} 9 & 5 \\ 1100 & 0111 \end{array}$$

$$\begin{array}{cccccccc} 128 & 64 & 32 & 16 & 8 & 4 & 2 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 \end{array}$$

$$(11001001)_{\text{Excess-3}} = (98)_{10}$$

$$\begin{array}{r} 128 \\ 64+ \\ \hline 192 \\ 8+ \\ \hline 200 \neq 1 = 101 \end{array}$$

b- Perform the following operations in binary:

$$101111/101$$

$$\begin{array}{r} \times 1001.0101 \\ 101 \overline{) 101111} \\ \underline{101} \\ 000111 \\ \underline{1010} \\ 01000 \\ \underline{1101} \\ 00110 \\ \underline{1101} \\ 001 \end{array}$$

$$\Rightarrow (1001.0101)$$

c- Convert and add the following numbers in Binary Coded Decimal BCD.
 $(83)_{10} + (77)_{10}$

$$\begin{array}{r} 1 \\ + 83 \\ 77 \\ \hline + 160 \end{array}$$

$$\begin{array}{r} 1 1 1 \\ + 1000 0 0 \\ 0111 \\ \hline 1 1 1 1 \\ 0110 \\ \hline 10110 0000 \Rightarrow \boxed{10110000} = 160 \end{array}$$

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d - Perform the following operation in 2's complement representation and indicate the overflow if occurred. Word length is equal to 6.

$$-32 + 20$$

$$\begin{array}{r} -32 \\ 20 + \\ \hline -12 \end{array}$$

$$\begin{array}{r} 1 0 0 0 0 0 \\ 1 1 1 1 1 1 \\ \hline 100000 \end{array}$$

$$\begin{array}{r} 32 16 8 4 2 1 \\ 20 \end{array}$$

$$010100$$

$$\begin{array}{r} 5 5 \\ -2, +2 -1 \\ -32, +31 \end{array}$$

1.5

$$\begin{array}{r} 100000 \\ 010100 + \\ \hline \boxed{1}10100 \end{array}$$

out of range

Rong resut

there is no overflow BCS the

length = 6

Question [2]: [10 mark]

a- Use Demorgan's law then simplify the following function (Use Boolean Algebra).

$$\begin{aligned}
 F &= \overline{(x+y)(\bar{x}+\bar{z}\bar{w})(\bar{y}+\bar{z}\bar{w})} \\
 F &= \overline{(x+y)} + \overline{(\bar{x}+\bar{z}\bar{w})} + \overline{(\bar{y}+\bar{z}\bar{w})} \\
 &= \bar{x}y + x(\bar{z}+\bar{w}) + y(\bar{z}+\bar{w}) \\
 &= \bar{x}y + x\bar{z} + x\bar{w} + y\bar{z} + y\bar{w} \\
 &= \bar{x}y + x\bar{z} + x\bar{w} + y\bar{w} \\
 &= \bar{x}y + x\bar{z} + x\bar{w} + y\bar{w}
 \end{aligned}$$

C.F.H

$$\boxed{F = \bar{x}y + x\bar{z} + x\bar{w} + y\bar{w}}$$

$x \cdot 0 = 0$

$x \cdot 1 = x$

$x + \bar{x} = 1$

$x \cdot \bar{x} = 0$

$x + 1 = 1$

$x + 0 = x$

$x + \bar{x}y = x + y$

$x \oplus w = \bar{x}w + x\bar{w}$

b- Use Boolean Algebra to simplify the following function.

$F = x + \bar{x}(x \oplus w)$

$F = x + \bar{x}(x \oplus w)$

$= x + (\bar{x}(x \oplus w))$

$= x + \bar{x}w + x\bar{w}$

$= x(1 + \bar{w}) + \bar{x}w$

$= x + \bar{x}w$

$\boxed{F = x + w}$

Question [3]: [10 mark]

A circuit has four binary inputs (a,b,c,d) and three binary outputs (x,y,z). The function of this circuit is to give the number of zeros or ones in its inputs according the following:

If a = 0 the outputs (xyz)₂ represent the number of zeros in the four inputs. (a,b,c,d)

If a = 1 the outputs (xyz)₂ represent the number of ones in the four inputs (a,b,c,d)

We assume that the combinations abcd = 0111 and abcd = 1000 will never occur. ← don't care

- 1- Give the truth table ✓
- 2- Write x as minterm expansion
- 3- Write y as maxterm expansion
- 4- Write \bar{z} as maxterm expansion

8 4 2 1	4 2 1	
abcd	xyz	\bar{z}
0 0000	100	1
1 0001	011	0
2 0010	011	0
3 0011	010	1
4 0100	011	0
5 0101	010	1
6 0110	010	1
7 0111	X	X
8 1000	X	X
9 1001	010	1
10 1010	010	1
11 1011	011	0
12 1100	010	1
13 1101	011	0
14 1110	011	0
15 1111	100	1

$$x_{(a,b,c,d)} = \sum m_i(0,15) + \sum d_i(7,8)$$

$$y_{(a,b,c,d)} = \prod M_i(0,15) \cdot \prod D_i(7,8)$$

$$\bar{z}_{(a,b,c,d)} = \prod M_i(1,2,4,11,13,14) \cdot \prod D_i(7,8)$$

10

NOR = AND \rightarrow POS $\rightarrow 0$
 NAND = OR \rightarrow SOP $\rightarrow 1$

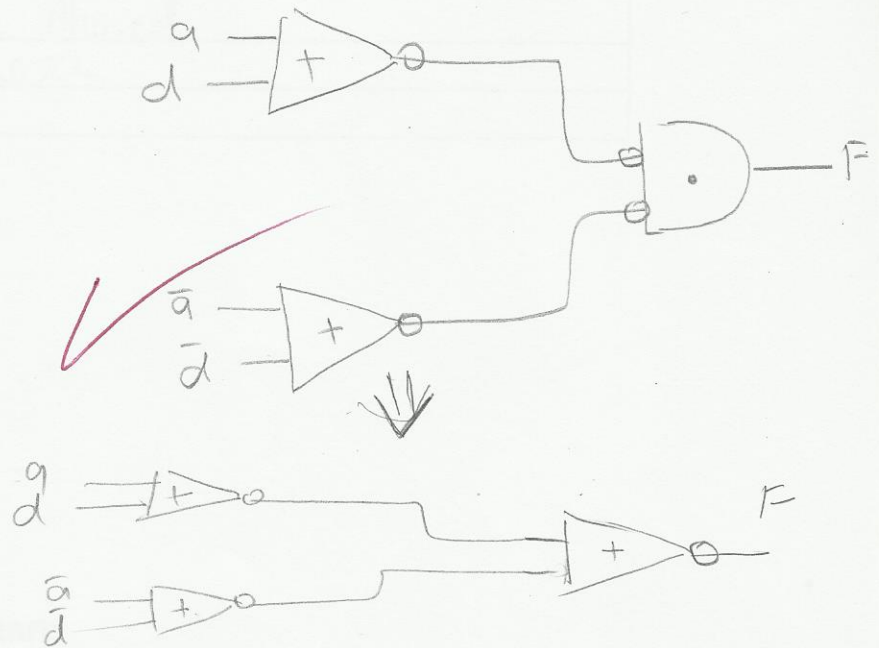
Question [4]: [15 mark]

a- Simplify F then implement it as 2 levels NOR-NOR

$$F(a,b,c,d) = \sum m(3,5,8,12) + \sum d(1,7,9,10,14)$$

cd \ ab	00	01	11	10
00	0	0	1	1
01	X	1	0	X
11	1	X	0	0
10	0	0	X	X

$$F = (a+d) \cdot (\bar{a} + \bar{d})$$



b- Simplify F then implement it as 3 levels OR-AND-OR

$$F(a,b,c,d) = \pi M(1,9,11,13,14,15) \pi D(5,8)$$

cd \ ab	00	01	11	10
00	1	1	1	X
01	0	X	0	0
11	1	1	0	0
10	1	1	0	1

$$F = \bar{a}c$$

$$\begin{aligned} F &= \bar{a}c + \bar{b}c\bar{d} + \bar{c}d \\ &= \bar{a}(\bar{b}c + c) + \bar{c}d \\ &= \bar{a}(\bar{b} + 1) + \bar{c}d \end{aligned}$$

